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UNCLASSIFIED- SOVIET BLOC INTERNATIONAL GEOPHYSICAL YEAR INFORMATION

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## PLEASE NOTE

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## SOVIET BLOC INTERNATIONAL GEOPHYSICAL YEAR INFORMATION

Table of Contents

## I. ROCKETS AND ARTIFICIAL EARTH SATELLITES

### Photographic Observation of Satellites With Maksutov Meniscus Telescope

The following is a complete translation of the article "Photographic Observations of the Satellites With the Maksutov Meniscus Telescope," by D. A. Rozhkovskiy, V. S. Matyagin, and A. V. Kharitonov, Astrophysics Institute, Academy of Sciences Kazakh SSR, which appeared in a recent issue of the Soviet scientific periodical Astronomicheskiy Zhurnal.

Photographic observations of Sputnik II with the Maksutov 50-cm meniscus telescope are described. The time was determined with the help of an oscillating plane-parallel glass plate placed before the correction lens of the telescope. The coordinates and time were determined to an accuracy of $\pm 2''$ and $0^{s}.001$, respectively. Other methods of observation and the errors are discussed.

At the mountain observatory of the Astrophysics Institute of the Academy of Sciences Kazakh SSR various methods of making photographic observations on artificial earth satellites were devised and tested. For this purpose small wide-angle and fast cameras were used, among others the camera with a "Sapphire Boyet" objective which was used for observations of the rocket-carrier of Sputnik I (D. A. Rozhkovskiy and V. S. Matyagin, Astron. tsirkulyar, No 186, 1957). However attention was paid chiefly to the organization of more accurate sputnik observations by means of an adequately equipped meniscus telescope of Maksutov design (D = 50cm, F = 120cm).

Although the narrow field of this instrument (about $5^{o}$) does not entirely meet the demands of the specified problem, nevertheless its other properties (the size of the effective aperture, the scale and quality of pictures, modest dimensions, and excellent mobility) were centainly not at odds with the purpose. At the beginning of December of last year, the equipment of the telescope was finalized and tested by photographing stars. The results seemed to promise improved accuracy in determining coordinates and recording instants of satellite motion. Observations on Sputnik II confirmed this and showed the possibility of applying the telescope under varied and even unfavorable satellite visibility conditions. At the present time the meniscus telescope is the basic instrument of the observation station organized by the institute, and in some respects it makes up for the lack of standard equipment designed for accurate photographic observations. The method used by us seems rather simple. Familiarization with this method may be of help in organizing satellite observations.

Optical-Electrical System. Observation Method -- For the synchronization of instants of motion with the indications of the chronometer we use an oscillating plane-parallel glass plate, periodically shifting the pictures in the focal plane of the telescope (D. A. Rozhkovskiy, Astron. tsirkulyar, No 187, 1958).

We should point out that a similar device was applied previously for various purposes of astrophysics and astrometry (see R. Trumpler, Astron. Nachr., 193, 213, 1912). For design consideration the plate (size $12 \times 12\ cm^2$, thickness 8 mm) is located before the correction lens of the telescope. It is set into oscillatory motion around a diagonal axis (i.e., the axis of least moment of inertia) by two electromagnets (figure 1). The switching-on frequency may be arbitrarily selected by means of an interruptor of simple construction. During oscillations of the plate at low amplitude, the picture undergoes a shift $\Delta S$ in a direction perpendicular to the axis:

$$\Delta S \sim \frac{n-1}{n} \alpha h$$

where $n$ is the index of refraction, h is the thickness of the plate, and $\alpha$ is the angular magnitude of a complete oscillation. For a given thickness $h$, the magnitude of $\alpha$ may be varied within certain limits. The same pertains to the velocity of transition of the plate from one extreme position to another.

During the operation of the plate double images of stars are obtained on the photographic plate, while the track of the sputnik undergoes breaks if the plate axis is parallel to its motion. The magnitude of $\alpha$ should naturally be selected from the condition of its minimum. The optimal values of $\alpha$ and of the velocity of oscillations are found from the following conditions:

1. The images of stars which will further be selected as references for the analysis of the picture (i.e., stars mostly of the 7th - 9th magnitude) should exhibit a clear separation into two components. This ensures high accuracy in setting the filaments of the measuring instrument on the star.

2. The parallel shift of the links of the track should be 2-3 times larger than the thickness of the track. This enables us to obtain a clear and easily measurable fine structure of the "break" (see below).

3. The time of transition of the plate from one position into another should be such as to make the corresponding mean linear velocity of picture shift of the same order as the velocity of track formation of the sputnik on the photoplate. If the last condition is met, it is not absolutely essential that the plate axis be correctly positioned with respect to the sputnik track (see below).



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The specified conditions should also include, of course, other considerations depending on the stellar magnitude of the sputnik, its angular velocity, the time of exposure, etc. However, within rather wide limits of variations of these magnitudes, the operating range of the plate may remain constant. Thus, in the case of the meniscus telescope the time of the plate transition is continuously kept at the order of 0.01 second, and the angular oscillation value at $2^{\circ}$. With this arrangement, pictures of Sputnik II trails which were suitable for measurements were obtained, the sputnik varying in brightness from zero to the third stellar magnitude, and its visual angular velocity from 0.3 to 1.0 degree/second.

On a reproduction of one of the original pictures of a track of Sputnik II, we present the typical shape of a part of the track (Figure 2a) limited by two successive breaks. They are formed during plate oscillations standardized in our observations at 2 $sec^{-1}$. The approximate direction of oscillations is indicated by a two-sided arrow. Because of elastic deformations of some parts of the equipment, the plate in any of its boundary positions performs some secondary damped periodic oscillations. Figure 2a clearly shows that the secondary waves tend to a nearly point shape. However, they would have the character of inevitable interferences if the corresponding time marks were missing. The presence of the latter makes the secondary oscillations very convenient for accurate readings, nearly in line in this respect with usual star pictures.

The timing is recorded by means of a loop oscillograph MPO-2 at a film speed of 25 mm/sec. For this purpose, one of the oscillograph vibrators is connected to special electric circuit (ABCD, Figure 1) passing through the cores of the electromagnets and a two-arm armature situated at the end of the plate axis and rigidly fixed to it. When the plate is held by one of the electromagnets in any of its extreme positions, the circuit is closed and the corresponding vibrator records a straight line on the film. During the transition of the plate into the other position the circuit opens, corresponding to a pip on the film. As will be shown, the correspondence between the structure of the track breaks and the oscillographic timing is easily and definitely established. The electrical plan, although rather simple, minimizes possible errors in timing due to inductance. Indeed, practically no supplementary inductance is supplied to ABCD, and the current pulses in this circuit mark directly the state of the oscillating plate. Errors may be introduced only by the oscillograph itself, mainly by the inertia of the vibrator.

For further explanation of the electrical plan we shall indicate the following details. The second vibrator of the oscillograph is intended for the recording of current pulses from the contact chronometer. The third vibrator is connected to the manual key $k_1$ permitting the marking of minutes. The manual button $k_2$ is for switching on the electromagnets.

The sequence of operations carried out during the observation of the sputnik is roughly the following. First of all the oscillation axis of the plate is preliminarily set according to the expected motion of the sputnik in one or another region of the sky. The telescope is set on the moving sputnik by means of a wide angle finder, accurately coordinated with the field of view of the telescope. The oscillograph is switched on, the shutter is opened, and when the sputnik appears as anticipated in the field of view of the telescope, the system of electromagnets is switched on by means of the button $k_2$. The key marks and records the closest minute. As the sputnik passes approximately the middle of the field of view, the electromagnets are briefly switched off by means of the button $k_2$. This introduces a certain controlling mark on the track picture and on the time recording which provides a check on their subsequent comparison.

The observations, despite the apparent simplicity, require the perfect coordination and speedy action of all participants. In this respect they hardly differ from observations on total phases of solar eclipses. The inaccuracy of ephemerides and strong fluctuations of the sputnik's brightness cause additional difficulties. A particularly responsible role falls on the observer manipulating the telescope during the photographing. It may be said without exaggeration that he has to have some feeling of art in the setting and in the selection of the instant of the picture. Under such circumstances it is nevertheless sometimes possible to succeed in obtaining two pictures of the sputnik.

Accuracy of Position and Time Determinations -- It is well known that time measurements of an extremely high accuracy that is difficult to obtain in practice are required for observations on artificial earth satellites. Let us see what correspondence may be established between the accuracy of the determination of the sputnik coordinates from the photograph by the meniscus telescope and actual accuracy following from the method of time recording used by us. With proper setting of the telescope and without the plate, the position of point objects is usually determined with an error not exceeding 0".5.

The introduction into the optical system of the telescope of a rather thick plane-parallel glass plate, of course, could produce some deterioration in the quality of star pictures. According to D. O. Matsukov (Astronomicheskaya optika, 1946, p 338), a plane-parallel plate located in the beam which converges to a point leads to the appearance of spherical aberration and chromatism. Thus, the effect of spherical aberration on the differences of focal distances for the external and internal zones of the mirror of the meniscus telescope may be evaluated with an accuracy up to terms of the second order inclusively from the relation:

$$\frac{y_2^2 - y_1^2}{F_1^2} \quad \frac{n^2-1}{2n^3} h,$$

where $y_2$ is the height of the external zone, $y_1$ is the height of the internal zone of the mirror, n is the index of refraction, h is the thickness of the plate, and $F_1$ is the distance from the mirror to the focal plane. With respect to the central part of the field of view of the meniscus telescope and the focusing on the middle zone of the mirror, the scattering circle should grow at the maximum to 0.01 mm. The effect of chromatism should be of the same order. Actual measurements of diameters of pictures of faint stars confirm these evaluations in general; the introduction of the plate increases the diameter of faint stars in the center of the picture from 0.03 (without plate) to 0.040-0.045 mm (with plate). A noticeable deterioration of the pictures is found only at the very edges of the negative. In general, the introduction of the plate, including insignificant losses of light to reflection, produces a drop in the penetrating power of the telescope by one stellar magnitude. We should note that under these circumstances the telescope still permits recording positively the tracks of moving point sources up to the 6th magnitude at a velocity of visible motion of one degree/second.

Therefore, within the limits of the plate, bounded by a circle of $2^o$ radius, the presence of the oscillating plate appears in the form of a symmetrical broadening of stars not substantially lowering the accuracy of determination of position. Outside this circle, as already mentioned, the quality of pictures deteriorates appreciably. Inasmuch as it is of interest to encompass in measurements the longest possible track, an attempt was made to evaluate the accuracy of measurements of coordinates near the corners of the picture. For this purpose four star groups were chosen in these positions at a distance of $2.5^o$ from the center. Each group contains four stars with known catalog coordinates. The coordinates of one of the stars were determined from the three bearings and the result was compared with the catalog value. The measurements and computations of coordinates according to the Deych method (A. N. Deych, Astron, zh. 44, 1948), rather convenient for the processing of sputnik tracks, were carried out by L. N. Tulenkova. The corresponding discrepancies with catalog data, expressed in angular units, are the following: 1".1, 1".1, 4".0, 1".3; for the center of picture the discrepancies were 0".9. It follows therefrom that the error in coordinate determination in total will hardly exceed 2" for the plate, if we take into consideration the remarks made above concerning the geometrical properties of the measured positions of the track.

Coming back to the reproduction (Figure 2a) of the track, we turn our attention to the schematic reproduction of the structure of the break (Figure 2c). On the sections ac, eg, ... the motion of the plate occurs under the action of the magnetic field, which on bc, fg, ... the motion is accompanied by an elastic deformation of the corresponding arm of the armature. On sections ce, gk, ... the reverse motion of the plate is caused by the elastic reaction of the armature. The period of the damping oscillations of the plate, as may be seen, is determined by the following expression:

$$T = \frac{4\pi}{L}\sqrt{\frac{I}{K}}$$

where L is the length of the armature arm, k is its elasticity coefficient, and I is the moment of inertia of the plate with respect to the axis. The sections bcd, fgh ... correspond to the closed circuit of the oscillograph; the sections ab, def, ... to the open circuit.

Figure 2c presents under the diagram of oscillations the corresponding diagram of recordings on the oscillograph. A reproduction of a section of an original record is given in Figure 2d. The question arises: which sections of the break should be chosen for the measurements of the coordinates? From a comparison of both diagrams of Figure 2c, it follows that for this purpose one should select the points b, f, l, ... and the corresponding times, or the peaks c, e, g, k... and the corresponding middles of the intervals of recordings $\beta$, $\gamma$, $\delta$, .... During the measurements one of the filaments should intersect in the longitudinal direction a continuous section of the track (upper or lower), while the other filament of the measuring instrument should bisect the track at one of the indicated points. In the measurement of the position of the reference star one should select the corresponding (upper or lower) picture.

It should be noted that a picture suitable for measurements may also be obtained when the plate axis and the trail are mutually perpendicular. In this case one should measure the disruptions of the track occurring at the instants when the velocities of both motions of the sputnik are added. The reproduction (Figure 3) shows the form of the track under such conditions. As already mentioned, the disruptions occur at a sufficiently high transit velocity of the plate from one position into another. The accuracy of the coordinate determination is here somewhat lowered. However, such conditions are rather exceptional and usually the plate has a sufficiently large choice of particularly clear track details, suitable for accurate measurements.

Let us now consider the accuracy of timing. It follows from the comparison of reproductions and explanatory diagrams of their pictures that in the measurements of the track, for example, at the points c, e, g, k, ... the tolerable error in recording of timing will not exceed the half of intervals of time $\beta$, $\gamma$, $\delta$, $\varepsilon$, ... which comprises about 0.002, 0.005, 0.002, 0.001 seconds, respectively. The last evaluation is considered as the limit of accuracy of measurements, afforded by the presently operating equipment.

With respect to the absolute accuracy of time, our possibilities are rather limited, owing to the unavailability of time service at the institute. The measures taken by us in this respect are reduced to the rational exploitation of the available means.

1. The maintenance of time is realized by means of a marine chronometer No 1188, of the Second Watch Plant. The chronometer is kept permanently in the basement of the main building under more or less unaltered temperature conditions. The current pulses from the chronometer contacts are transmitted to the observation room by wires. The pulse delay was checked and due to the short length of the line appeared to be much below 0.001 second. During the observations on the sputnik, a second chronometer, previously checked with the main one, is used for marking the minutes.

2. The daily advance of the main chronometer is constantly controlled. The average is +0.221 seconds

During the days of observations on the sputnik, the chronometer is verified every 4 hours with the rhythmic signals of radio station ROR. Reception is by audio, using a semiautomatic method. The variation of the chronometer movement during 4 hours does not usually exceed $\pm 0^s.02$.

In the operation of the oscillograph a possible phase shift of vibrators is taken into account, unevenness of film movement, etc.

The random error due to unevenness of the chronometer movement we evaluate at $\pm 0.005$ second. Other errors may be related to discrepancies in rhythmic signal transmission.

The above can be illustrated by the following results from processing of the tracks of Sputnik II, obtained on two pictures on 25 January of the current year.

| No | GMT | $\alpha$ 1950.0 | $\delta$ 1950.0 |
|---|---|---|---|
| 1 | $13^h29^m39^s.437$ | $23^h36^m34^s.6$ | +51°49'25" |
| 2 | 13 29 39.929 | 23 37 44.6 | +51 44 28 |
| 3 | 13 29 40.436 | 23 38 58.7 | +51 39 09 |
| 4 | 13 31 08.254 | 2 20 21.3 | +25 17 43 |
| 5 | 13 31 08.749 | 2 20 56.8 | +25 07 10 |
| 6 | 13 31 09.252 | 2 21 33.8 | +24 56 25 |

Coordinates of the location of observations:

$\lambda = 5^h07^m49^s.76 \pm 0^s.0$

$\varphi = 43°11'16''.9 \; 0''.6$

$H = 1450m \pm 50M$

The above method for observations on artificial satellites on the meniscus telescope makes it possible to obtain sputnik coordinates with an error not exceeding $\pm 2$ seconds of arc. The error in the recording of timing may be reduced to 0.001 second of time (which corresponds to an actual accuracy of coordinates of $\pm 3.6$ seconds of arc at a velocity of the visible motion of the artificial satellite of one degree/second) with an adequately organized time service.

The unquestionable advantage of this method is the utmost simplicity and infallibility of operation of the whole equipment. Thus, during the period from 22 January to 11 February six pictures of Sputnik II were obtained, for which all passages of the sputnik over Alma-Ata were exploited which were favorable in regard to weather.

The method allows obtaining a practically continuous track of the satellite, thus offering a definite advantage in the determination of brightness. In comparison with the shutter situated before the plate there is an obvious advantage: the need for introducing complex corrections in the time determination becomes superfluous. A more perfect analog of the oscillating plate is the moving box. However, it requires considerable changes in the construction of the telescope. The advantage of such a "marking" box before the oscillating plate is also doubtful with respect to increasing the accuracy of time recordings. It seems to us that it is worth considering the problem of using, instead of the plate, the corrective lens itself, imparting to it small oscillations during the photographing of artificial earth satellites; this will certainly give a gain to the penetrating power of the telescope. It seems to be useful to equip with such lenses or plane parallel plates, for example, efficient meniscus telescopes with a focal distance of 40 to 50 cm and a field of view of 30 to 15°, intended for observations of artificial satellites.

The authors are indebted to I. N. Tulenkova for her help in carrying out measurements and computations. (Astronomicheskiy Zhurnal, Vol 35, No. 3, May-Jun 58, pp 479-485)

Chinese Publish Notes on Sputnik III Carrier-Rocket Observations

The Purple Mountain Astronomical Observatory of the Academia Sinica on 15 August published a schedule of times and places indicating when and where in China the carrier-rocket of Sputnik III would be visible, weather permitting, to the naked eye. A small-scale sketch diagram of China indicates the passages of the satellite as along a line approximately from northwest to southeast. Up to 1100 hours on 15 August, this satellite has been circling the Earth for 3 months, and during this time, it has made 1,252 revolutions. The carrier-rocket has made 17 more circuits than the satellite. The carrier-rocket is brighter and more easily seen than the satellite. Because of the braking effect of the atmosphere, the orbital period is slowly decreasing. The carrier-rocket's cross section is greater than that of the satelliet; hence the braking effect is greater and the orbital period of the carrier-rocket is decreasing faster than that of the satellite. At present, the orbital period of the carrier-rocket is 102.2 minutes and is decreasing by 3.1 seconds each day.

On the lines of passage on the diagram, two imaginary points A and B are indicated. Point A is at approximately 50 degrees north latitude. The times given in the schedule are for point A. It takes about 6 minutes for the carrier-rocket to pass from the zenith over A to the zenith over B. A column in the schedule indicates the approximate latitudes of the localities where the carrier may be visible at the indicated times. Since the carrier-rocket is constantly turning [tumbling] as it moves, its reflected brilliance varies from bright to dim in a few seconds' time. In good weather, the area of visibility extends about 700 kilometers on either side of the lines on the diagram. (Peiping, Jen-min Jih-pao, 16 Aug 58, p 6)

## II. UPPER ATMOSPHERE

### Ionospheric and Magnetic Storms Reported by NIZMIR Scientist

L. N. Lyakhova, Scientific Research Institute of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation (NIZMIR), describes efforts made at the institute during the IGY for obtaining full materials for studying ionospheric and magnetic disturbances and their connection with geophysical phenomena. These are reported in the article "Ionospheric and Magnetic Storms" which appeared in the Soviet popular science magazine, Priroda.

In September 1957 together with a heightening of solar activity there were noted such phenomena as the spread of auroras as far as regions in the lower latitudes, strong ionospheric and magnetic disturbances, the strengthening in the intensity of Earth currents, etc. In connection with these, in NIZMIR, compilations of variations in solar activity with geophysical phenomena were made.

The studies showed that solar activity in September grew considerably in comparison with preceding months: If in August the relative number of sunspots was 202, then in September it was 265. During September four powerful active regions passed through the visible disc of the Sun. During this same time five very large ionospheric and magnetic disturbances were observed.

The most intensive were two storms, one arising at the beginning of the month and the other at the end of the month. Both of these were associated with the same, most active region of the Sun, in the northern hemisphere at latitudes of 05-30° N and longitudes of 300-350°. Photographs of the photosphere and the chromosphere in this region are presented in the article. This region rapidly developed and flared up in the course of three 27-day revolutions of the Sun.

In the first revolution, the active region was insignificant and it caused only a weak disturbance (5-6 August). In the next revolution (at the end of August to the beginning of September) the region already consisted of three groups of spots, one of which attained an area of 2,590 million parts of the Sun's hemisphere, and the passing of this group through the central meridian was accompanied by intensive geophysical phenomena. In the third revolution this active solar region disintegrated, but was still very intensive and caused a new magnetic storm, beginning suddenly on 29 September at 0015 hours, and a strong ionospheric disturbance.

Lyakhova gives more details on the results of the intensifying of solar activity in the second revolution of the Sun when bright floccular fields were observed and a number of chromospheric flares were noted. One of them, the most intensive, passed on 31 August at 1230 GMT and was accompanied by simultaneous increases of radio emission at frequencies of about 500 megacycles. Through 38 hours after this flare (2 September at 0315 GMT) a very strong magnetic storm began with active periods as follows: from 1200 on 2 September up to 0300 GMT on 3 September and from 0700 to 2000 GMT on 3 September. A new powerful flare on the Sun, accompanied by heightened radio emission at frequencies of about 500 megacycles and of about 1,500 megacycles was observed 3 September at 1026 GMT.

The suddenly increased magnetic activity (a new storm began) passed on 4 September at 1254 GMT. The most active period of this storm lasted up to 1100 GMT on 5 September.

Simultaneously with the recording of variations of the magnetic field, observations on the state of the ionosphere were conducted. Disturbances of the magnetic field and the ionosphere are closely associated with each other.

Data on variations of the Earth's magnetic field and deviation of the critical frequencies from average values during the period 4-5 September 1957 are presented in graph form. From the graph it can be seen that after the beginning of the magnetic disturbance (1254 GMT) a lowering of the critical frequency of the $F_2$ ($f_oF_2$) layer began and during the most active period of the magnetic storm reflections from the $F_2$ layer were, in general, absent. With the weakening of the magnetic field the critical frequencies approached normal values.

In the middle latitudes from 2 to 7 September a strong lowering of the critical frequencies of the $F_2$ ($f^oF_2$) layer was observed reaching 70% of the relative normal values.

The most intensive ionospheric storm arrived at night from 4 to 5 September. At certain hours clouds of the sporadic E ($E_s$) layer appeared, so dense that they prevented the reflection of signals from the $F_2$ (screening) layer.

In the north during almost all the storms, with the exception of certain hours, the full absorption of short-wave signals was observed. During especially active storm periods a full cessation of short-wave radio communication in all direction occurred.

From 2 to 4 September the IGY World Agency (Washington) announced a Special World Interval. During this interval all geophysical stations of the world conducted increased observations according to a specially developed program with the aim of obtaining fuller material for future investigations of these phenomena.

Simultaneous observations for solar activity, changes of the Earth's magnetic field, and the state of the ionosphere give abundant materials for recognition of the nature of these phenomena and are of great value for predicting possible disruptions of radio communication. (Priroda, No 6, Jun 58)

## Purple Mountain Astronomical Observatory

The Purple Mountain Astronomical Observatory is located at an elevation of 267 meters above sea level on the third highest of three peaks of Purple Mountain, an eminence a few kilometers east of Nanking. It is operated by the Astronomical Institute of China's Academia Sinica, which is the leader in this field in China. The diameter of the dome of the largest of the four [at least] observatories is 8 meters, and this structure contains the most powerful telescope that China possesses at present. On occasions section of the heavens are photographed by telescope; and with the use of devices to permit long exposures, stars of lesser magnitude and at greater distances than otherwise can be detected. To photograph star nebulae, the exposures may have to be several hours long. The study of small planets and asteroids, and of variable stars is a common occupation in this observatory. There is also an observatory without a dome, but with a long narrow roof opening on a north-south line, for observing star transits of the meridian.

An important part of the observatory's equipment is the astronomical clock which is kept in a specially constructed room where constant temperature and pressure are maintained. This clock is accurate to thousandths of a second. There also are here a number of delicate instruments for observations and measurements, and for the receipt and dissemination of various kinds of scientific data and information. It has a post at Siccawei in Shanghai whose time signals are broadcast daily to all parts of the country.

Besides the night observers, many other staff members work during the daytime in the library, laboratories, mathematical calculations room, and photographic dark rooms. On the electrically operated calculating machine much scientific data are ascertained and published in an "Astronomical Annual" (T'ien-wen Nien-li), which is indispensable to the navy and to aeronautical and engineering agencies. The laboratories conduct studies concerning photometry and the spectrum. Studies of the Sun and the activities on its surface are also made. These are invaluable due to the effect of such solar activities on telecommunications.

Whereas before liberation this observatory had a staff of less than ten research workers, now the number is more than ten times as many, and there has been a great increase in the library and in its equipment. The training of astronomical research workers is a matter of constant concern. The research work of the observatory is carried out in accordance with a carefully mapped-out program, and long-range plans for future expansion and advances have been developed. There are at present branch posts at Shanghai, K'un-ming, Tsingtao, Tientsin, and Peiping. In the near future a complete observatory is to be established at Peiping. (Peiping, Lu-hsing-chia, No 7, 22 Jul 58, pp 46-47)

## III. METEOROLOGY

### Method of Determining Pilot Balloon Altitudes

The article, "Theory of Pilot Balloon Observations From a Single Point," by I. G. Kurdiani, Tbilisi State University imeni Stalin, gives the following information:

The use of pilot balloon observations from a single point is based on the steadiness of the vertical velocity calculated by theoretical means. However, the calculated velocity in some cases can differ considerably from the actual vertical velocities because of the constant presence of natural vertical movements of the air at different altitudes. This circumstance is the reason for distortions in wind velocities and directions which are determined by this method.

With the aim of bringing theodolite observations made from one point into line with true altitudes, it is necessary to determine by calculated (theoretical) vertical velocities not the altitudes but only projections of the pilot balloon on a horizontal plane considering them as approximations. In the future, even the calculations of the true altitude must be based on theoretical calculations resulting from so-called sector velocities of the pilot balloon.

The problem is solved by considering projections of the pilot balloon on a horizontal plane xoy in a system of north and east oriented coordinates for two successive intervals of time. Several triangles are formed on the plane xoy during the time $t_2-t_1$, the area of which is determined by a formula containing terms representing the so-called sector velocity of the pilot balloon in the plane of the horizon. Jointly with these triangles the areas of certain trapeziums are considered for which the true altitudes of the pilot balloon serve as bases, and the height is the path of its horizontal shifting.

The article includes formulas, graphs, and tables used in the computations. Kurdiani says that if we consider the vertical velocities as coinciding with the true velocities, then by this method altitudes are obtained which are extremely close to the actual altitudes. If there is some divergence between them, as happens in practice, the method of sector velocities makes it possible to establish not only an agreement between observations and calculated altitudes but makes the latter more reliable. (Soobshcheniya Akademii Nauk Gruzinskoy SSR, Vol 20, No 5, 1957, pp 533-539)

Effect of Ground Relief on Pressure at Sea Level Studied

The effect of irregularities of the Earth's surface on determinations of the climatic pressure field at sea level are considered in "Calculation of the Effect of Irregularities of the Earth's Surface in Determining Pressure at Sea Level," by Sh A. Musayelyan, Central Institute of Prognosis.

Ye. N. Blinova (Determination of Pressure at Sea Level, Doklady Akademii Nauk SSSR, Vol 92, No 3, 1953) solved the problem of determining the mean planetary pressure field (centers of action of the atmosphere) for large time intervals on the assumption that the distribution of temperature in the atmosphere is known. In his article, Musayelyan attempts to show that the results obtained by Blinova can be improved by introducing the effect of the relief of the Earth's surface into the calculations.

A linear stationary problem is solved taking into account the sphericity of the Earth. In the linearization of the problem a method of small disturbances is used assuming that the motion of the atmosphere consists of a basic motion, zonal circulation and superpositions of small disturbances on the latter.

The results of the calculations are presented and these are shown to compare favorably with actual material from observations. (Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 5, May 58, pp 625-635)

## IV. GRAVIMETRY

Gravity Determinations at Sea

V. A. Kuzivanov, Institute of the Physics of the Earth, Academy of Sciences USSR, in an article entitled "Determination of Gravity at Sea by Gravimeter," considers the problem of measuring the force of gravity at sea using a gravimeter. The principal difficulty, according to Kuzivanov, is in the calculation of disturbing influences arising as a result of the motion of the gravimeter base. These disturbances are the vertical, horizontal, and rotational accelerations, and also the inclinations of the gravimeter frame caused by the movements of the ship. To determine those disturbing effects for which calculations are necessary, a differential equation for the movement of a gravimeter pendulum on a moving frame is studied.

Kuzivanon says that in measuring gravity at sea it is expedient to have a gravimeter with a highly damped system, the pendulum of which is close to the water level. In this way the effect of perturbing terms will be considerably lessened and many of them can be ignored. A further decrease in the perturbing effects is achieved by the use of two oppositely aligned pendulums.

The readings of these pendulums must be corrected for the effect of the squares of the angles of inclination $\alpha$ and $\beta$ of the instrument's frame and for the effect of the horizontal accelerations $\ddot{X}$ and $\ddot{Y}$. For the introduction of the indicated correction it is necessary to have a record of long period pendulums and of vertical and horizontal accelerometers. (Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 5, May 58, pp 649-654)

V. SEISMOLOGY

Conference on Microseisms Held in USSR

A report of the interdepartmental conference on Microseisms which was held in the Main Administration of the Hydrometeorological Service USSR from 27-29 January 1958, is given in a Soviet scientific periodical.

The aim of the conference was the discussion of microseismic observations conducted by the Soviets according to the IGY program and special investigations of microseisms conducted by different Soviet institutions.

Six tripartite microseismic stations designed for determining the direction to storms at sea and on the ocean were organized by the Soviet Union. These stations operate according to the IGY program. Regular observations in the majority of them began on 1 June 1957. The microseismic stations are located at these points: Petropavlovsk, in Kamchatka; Yuzhno-Sakhalinsk, Vladivostok, Vyborg, Murmansk, and Barentsburg on the island of Spitzbergen. The first five stations belong to the system of the Hydrometeorological Service USSR and the Barentsburg station to the system of the Main Administration of the Northern Sea Route. Over-all supervision of the work of the stations is carried out by the Central Institute of Weather Forecasts, Main Administration of the Hydrometeorological Service (GUGMS). Episodic observations for determining the source of microseisms by a special method which ensures the high accuracy of these observations are conducted in the Crimea by the Institute of the Physics of the Earth, Academy of Sciences USSR.

The leading microseismic stations and representatives of the institutions of the Academy of Sciences USSR, Moscow State University, Leningrad State University, and institutions of the Hydrometeorological Service, took part in the conference.

The principal report was given by F. I. Monakhov (Central Institute of Weather Forecasts and Institute of the Physics of the Earth, Academy of Sciences USSR) entitled, "Operation of Microseismic Stations and Some Results of Their Observation." An analysis of the work of each station was given in the report. Certain measures for ensuring more reliable observations were recommended. The results can be reduced to these principal points:

1. Observed directions according to which storm microseisms are radiated to stations located directly at the seashore frequently do not correspond to the direction to the cyclones and are even opposite to them. Considerably better conformity is obtained when the mocroseisms are observed at points located in the depths of the continent at distances of several hundred kilometers from the shore. For example, the directions to the sources of microseisms observed in the Crimea were in better agreement with the directions to cyclones in the North Atlantic than according to observations at Vyborg, and, in particular, at Murmansk.

2. In all of the western stations the microseisms are strongest when the cyclones are located near the Scandinavian shores over the Norwegian and Barents Seas. Microseismic oscillations are considerably weakened when the cyclone functions over the north Atlantic south of Iceland and Greenland; and during these cases the directions toward the sources of the microseisms, according to observations in Crimea, are systematically inclined toward the north from the direction of the cold front and the cyclone centers.

3. During cyclonic activity near shores, conditions of disturbances in microseisms are better expressed than in those cases when the cyclones are located in the open parts of the seas and oceans.

Means of further improving the method of determining directions toward sea storms were touched upon in the report.

The principal recommendation in this direction was: the location of stations in the depths of the continent and the lengthening of the profile according to which the phase differences of the microseisms are determined.

A second report by F. I. Monakhov was devoted to the results of the investigations of microseisms conducted during 1956-1957 in the Crimea by the Institute of the Physics of the Earth, Academy of Sciences USSR. The purpose of these investigations was the study of the structures of microseismic waves and the improvement of methods for determining the directions toward the sources of microseisms. At the same time, conditions of disturbances in microseisms in the Black Sea and in the Atlantic Ocean were studied. The observations of microseisms were conducted with azimuth apparatus with the axes of maximum sensitivity of the seismographs inclined at an angle of 45 degrees to the horizon, by tripartite stations and profile apparatus. The latter consisted of eight seismographs, established according to profiles, the maximum length of which consisted of about 20 kilometers. Registration of microseisms at each point was by the synchronous reception of time signals transmitted every 20 seconds. The principal results of this work are:

1. Love waves are almost wholly absent in microseismic waves from both nearby and distant sources. Microseisms on the whole consist of Rayleigh waves. Fluctuations in microseismic waves are for the most part extremely complex in character because of waves of interference propagated in different directions. Regions of disturbance of microseisms are usually considerable in extent.

2. For determining the true directions of the propagation of microseisms according to the method of position-phase correlation, it is necessary to use multiple point profile installations making it possible to separate noninterference waves on the recordings.

The report of N. V. Veshnyakov (Moscow State University) attracted great interest. This concerned the errors in determining the azimuths of the directions of the spread of the microseisms according to tripartite station methods. It was shown that even in the most advantageous system of seismic recording apparatus possible misalignments of the parameters of the instruments cause phase shifts of only 0.06 seconds. Thus, the phase shifts are most sensitive to the misalignment of the electrodynamic coupling coefficient $\sigma$ 2. The general conclusion from the report is the recommendation to increase the distance between seismographs.

Reports by S. I. Masarskiy (Talgar Geophysical Station, Academy of Sciences USSR) and L. N. Lyasenko (Moscow State University) were related to the study of the sources of frequently observed short period microseisms on the recordings of seismic stations located near Lake Issuk-Kul'. Both speakers arrived at the conclusion that the sources of the indicated microseisms are winds blowing over Lake Issuk-Kul'. S. I. Masarskiy considers that the presence of counter winds is the condition for the excitation of microseisms in Lake Issuk-Kul'. According to L. Lysenko microseisms arise also with winds from a single direction as a result of the formation of standing waves on the surface of the lake near reflecting shores.

As an example of this same scheme A. F. Kostina (Institute of the Physics of the Earth, Academy of Sciences USSR) reported the results of microseisms recorded by the Simferopol' seismic station. It was established that short period microseisms in Simferopol' have as sources, cyclonic passing over the Black Sea, and microseisms with a period of more than 4 seconds are formed as a result of cylonic activity over the North Atlantic and adjoining seas.

The report of T. A. Proskuryakova (Moscow State University) contains data on the intersections of the sources of microseisms according to observations in Pulkovo and in the Crimea by means of the tripartite stations of Moscow State University. For a 2-year period about 200 intersections were obtained in which, in all cases, the sources of microseisms coincided with the rear areas of cyclones, but the sources themselves could not be found.

In reports by Ye. M. Lin'kov (Leningrad State University) and L. N. Smirnov (Moscow State University) considerations in relation to instrumental development directed toward increasing the precision of measuring phase shifts of microseisms using the electronic phasometer (Ye. M. Lin'kov) and on the possibility of eliminating the influence of extraneous electrical interferences in the lines of communication between the seismographs and the galvanometers (L. N. Smirnov) were expressed. (Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 7, Jul 58, pp 933-934)

## VI. ARCTIC AND ANTARCTIC

### Soviet Expedition Denies Existence of Antarctic Volcanoes Originally Reported by Norwegians

The discovery of one, or two adjoining, active volcano or volcanoes was reported by Norwegian antarctic explorers of East Antarctica in 1931. These mountains, or volcanoes, were said to be located on the Amery Ice Shelf Glacier, Lars Christensen Coast, and were called "Sjovold Mountains."

There has been a great deal of controversy and difference of opinion in the past 26 years regarding the existence and elevation of these mountains. The latest US map of Antarctica published in 1956 by the US National Committee for the IGY once more brought up the question of the existence of such a volcano or volcanoes. This map indicates a mountain on the Amery Ice Shelf, with the figure "3,220 ?" -- meaning the elevation in meters. The question mark apparently signifies either that the existence of the mountain is questioned, or the exact height. If an elevation of 3,220 meters existed, it would be the highest mountain on the entire coast of Antarctica within a range of thousands of kilometers. Such elevations are to be found only at a great distance from the coastline, and only about 3,000 kilometers west of the Amery Ice Shelf (Schwabenland Mountains) and 6,000 kilometers east of the Amery Ice Shelf (Victoria Land, Mt Sabine). The elevation of 3,220 meters exceeds the elevation of the South Pole by 400-500 meters.

This version of the controversial geographic discovery was finally refuted by the Soviet Antarctic Expedition on the Lena, headed by O. A. Borshchevskiy, as a result of cartographic and geographic studies made in 1957. In February 1957, the entire area of the Amery Ice Shelf, the Ingrid Christensen Coast and Lars Christensen Coast, were not only surveyed in detail from the air and by land, but also photographed. The expedition camp was located on the ice, about 50 kilometers from the supposed location of the volcanoes. Aerial photography was accompanied by overland astronomic-geodetic work. A number of astronomic points were established, and as a result the location of individual elevations, their contours and height, were shown with great exactness.

It is now possible to make the following categorical statement. The Amery Ice Shelf is not interrupted on its entire expanse by any rocky elevations rising above its surface, especially not by a mountain or volcano. Only along the southern edge of the shelf, numerous nunataks of moderate height (not exceeding 250 meters above sea level) are found on the continent. The western continental edge of the Amery Ice Shelf has some higher nunataks. One of them, Munro-Carr [?] Mountain, actually reaches a height of about 1,000 meters, but it is not situated on the Amery Glacier and is not a volcano.

The conclusion drawn by Soviet scientists became particularly evident after the flights made on 21 and 22 February, especially during the second flight. The course of the plane passed almost exactly over the point where, according to the US Sailing Directions, the Sjovold volcanoes were supposed to be located. However, nothing but the pure white snow surface of the Amery Ice Shelf was spread out below, the shelf being visible from edge to edge. Visibility on that day was excellent. There were no traces of a volcano of even 1,200 meters, not to speak of 3,200 meters, which would have been about 20 kilometers off the course of the plane. At the same time, the nunataks surveyed the day before, at the south edge of the Amery Ice Shelf, were not high, i.e., about 100-250 meters, but could be seen plainly at a distance of 150-200 kilometers off the course of the plane.

Thus the version concerning the Sjovold mountains, or active volcanoes, which originated 26 years ago and was considered plausible up to the time of the explorations of the Soviet Antarctic Expedition, has been definitely disproved by these explorations. Such volcanoes do not exist. (Leningrad, Izvestiya Vsesoyuznogo Geograficheskogo Obshchestva, Vol 90, No 4, Jul-Aug 58, pp 305-309)

## Soviet Expedition Data on White Island

During the past 25 years, a new ice-capped island, called White Island on British maps, has been shown on Antarctic maps at a point about 50 degrees eat longitude, where Enderby Land borders on Prince Olav Land Usually, this island is shown as being about 70 kilometers from the coast, and, judging by its representation on the maps, the island is about 20-25 kilometers long.

East Antarctica has few large islands, and possible only Drygalski Island may be considered as being of equal significance. That is why White Island deserves the attention geographers, especially since several interesting questions are connected with the nature of the island and its very existence: Does White Island really exist? What is its elevation? Is there one or two islands?

There have been many contradictory reports on this island by various expeditions (Norwegian, British, and US). The latest foreign source is a US map published in 1956, which shows the White Island and the ice tongue, originally mentioned by Mawson in 1930. The island was given the Norwegian name Kvitoya, since it was first discovered by the Norwegians in 1930, and the year of the discovery of the ice tongue was also given as 1930. The location of the island and ice tongue does not entirely correspond with the coordinates indicated in the Sailing Directions.

In the only Soviet source, a map published in 1956 from various materials (scale 1:2,500,000), White Island, improperly called Ostrov Vite, was designated with an elevation of 1,200 meters, the same as in the British Sailing Directions. The ice tongue mentioned in earlier sources was omitted.

The following table combines the various contradictory data.

| Source | Island | Glacier Tongue | Elevation (meters) | Coordinates Lat. | Coordinates Long. | Date | Remarks |
|---|---|---|---|---|---|---|---|
| Riiser-Larsen | +* | -* | - | - | - | 15-1-30 | - |
| Mawson | + | + | - | 66-22S | 48-31E | 13-1-30 | Coordinates of ice tongue |
| L. Christensen | + | - | - | 67-15S | 48-30E | 1939 | Coordinates of island |
| US Sailing Directions | + | + | 1,200 ft. (ice tongue) | - | - | 1943 | |
| British Sailing Directions | + | + | 1,219 m (island) | 67-10S | 48-30E | 1948 | Island probably same as ice tongue. On it is Mt. Christensen. |
| US Map | + | + | - | - | - | 1955 | - |
| Soviet Map | + | - | 1,200 m | - | - | 1956 | - |

* Plus and minus signs indicate the presence or absence of information on the island and glacier tongue in the sources used.

As seen from the data in the preceding table, there is a great deal of discrepancy in the information previously obtained. Especially the data on the location of Mount Christensen and the elevation of White Island have been very confusing.

At the end of March 1957, the Soviet marine expedition on the Lena, headed by O. A. Borshchevskiy, made a comprehensive study of the area of Amundsen Bay, White Island, Mount Christensen, etc. As a result of these explorations, and especially as a result of aerial photography, the location of the coastline was corrected (in some places by as much as 100 kilometers), some questions were finally resolved, i.e., the question of the existence of the island and ice tongue north of Amundsen Bay, and their elevation.

The following facts have been established:

1. White Island actually exists. It is a fairly large (about 20 kilometers long) ice dome of the same type as Drygalski Island. Its elevation is 300 meters; the geographic coordinates are 66-35 S and 48-56 E. The true location of the island is 40' (about 80-90 kilometers) more north than estimated by US and British Sailing Directions. It is interesting to note that the width of the island is closer to the width of the glacier tongue according to previous data.

2. At present there is no glacier tongue of any kind in this area. The Lena passed a point 10' south of the tip of the "tongue" during the night of 13-14 March; a second time, further south, on 18 March; and a third time even further south, on 27 March. The glacier tongue was not observed from the ship; neither was it visible from the air, during flights made with good visibility.

It is very likely that, because of poor visibility and inexact determination of coordinates, the Norwegians and British gave inexact coordinates in both cases, even though they saw White Island. This started the version of the island and ice tongue. It is also possible that a large iceberg was taken for an ice tongue. Huge icebergs were seen by the Soviet expedition in March 1957 a litte further west (near Prince Olav Land) and east (near Enderby Land).

3. As seen from the north, the summit of Mount Christensen, which is located 125 kilometers south of the island on the mainland, is visible above the dome of White Island. The elevation of this mountain is about 1,200 meters. This has caused the erroneous statement contained in British Sailing Directions that the island is topped by a mountain with an elevation of 1,200 meters above sea level. (Leningrad, Izvestiya Vsesoyuznogo Geograficheskogo Obshchestva, Vol 90, No 4, Jul-Aug 58, pp 309-314)

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